5 Watt per Kilogram Tritium Betavoltaic, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

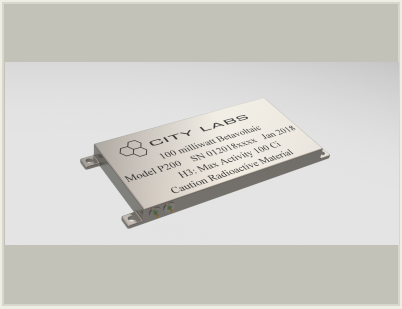
The proposed innovation will significantly improve the performance of tritium-powered betavoltaic batteries through the development of a high bandgap InAlP diode coupled to a high beta-flux thin film metal tritide. Tritium has a power density of 300 W/kg and City Labs' new metal hydride film has a power density approaching 70 W/Kg and can be expanded to 100 W/kg.This project will investigate the performance improvement from a wide bandgap semiconductor diode, specifically with the goal of achieving >10% beta-electron energy conversion efficiency. The device will be built by City Labs with its tritium beta emitter expertise and MicroLink's metalorganic chemical vapor deposition (MOCVD) capability.

The proposed Phase I research seeks to develop an InAlP p/n junction with a high beta-flux metal tritide for use in betavoltaic power sources. The betavoltaic p/n junction will increase the efficiency of betavoltaic devices from 8% up to 12% based on the incident tritium beta flux. The secondary goal is to investigate the release of the betavoltaic epitaxial layer through the removal of the substrate via lapidary and/or chemical etchants.

Anticipated Benefits

City Labs anticipate that the proposed work will result in the creation of a betavoltaic battery with a volumetric energy density 100 times that of lithium batteries (integrated over 20 years of continuous power). This ultra-high, energy density will allow tritium betavoltaics to be introduced to a mainstream market in a number of potential NASA applications, including high value deep space missions, CubeSats, independent power sources for spacecraft electronics and backup communications systems

Applications include: defense/security applications, anti-tamper, nuclear storage/ device monitoring applications, satellite power supplies, including CubeSats, autonomous wireless sensors, and medical bionics/ implants. City Labs has sold prototype and commercial batteries into select high value markets with customers such as Lockheed Martin and NASA's JPL and currently has letters-of-support from Orbital ATK and Lockheed Martin Space Systems for the proposed betavoltaic power source.



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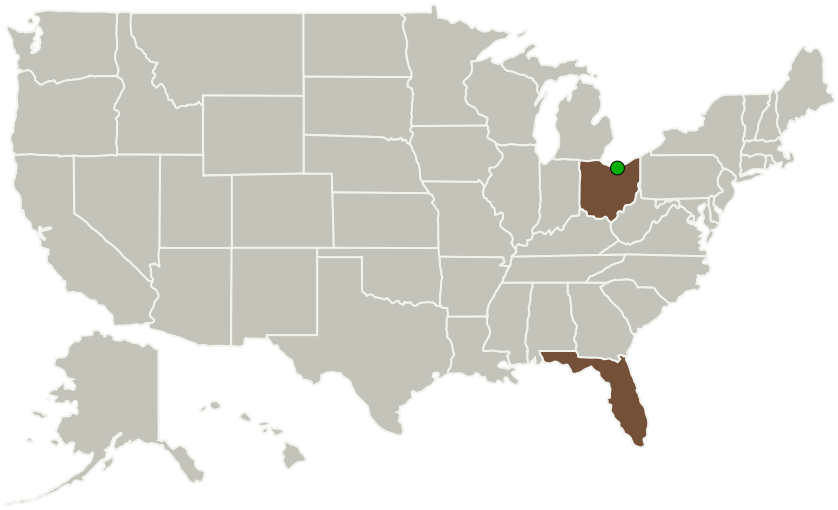
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
City Labs, Inc.	Lead Organization	Industry Minority-Owned Business	Homestead, Florida
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Florida	Ohio

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140874)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

City Labs, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

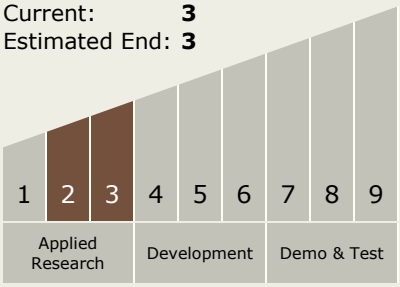
Carlos Torrez

Principal Investigator:

Peter Cabauy

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Images

Briefing Chart Image
5 Watt per Kilogram Tritium Betavoltaic, Phase I
(https://techport.nasa.gov/image/128608)

Final Summary Chart Image
5 Watt per Kilogram Tritium Betavoltaic, Phase I
(https://techport.nasa.gov/image/132679)

Final Summary Chart Image
5 Watt per Kilogram Tritium Betavoltaic, Phase I
(https://techport.nasa.gov/image/130720)

Final Summary Chart Image
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(https://techport.nasa.gov/image/134747)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.2 Energy Storage
    - TX03.2.1 Electrochemical: Batteries

Target Destinations

Earth, The Moon, Mars